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**Assessment of the Think Like a Commander
Training Program**

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U.S. Army Research Institute

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**Assessment of the Think Like a Commander
Training Program**

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FOREWORD

Success in future operations depends on the ability of leaders and Soldiers to think creatively, decide promptly, exploit technology, adapt easily, and act as a team. A partnership of Army leaders, scientists, and trainers must create and employ effective methods and techniques to ensure that future leaders, Soldiers, and teams possess those qualities. The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) as part of its Science and Technology Objective: IV.SP.2002.02, Methods and Measures of Commander-Centric Training, is developing a variety of new training methods and performance measurement methods to enhance the U.S. Army's ability to produce the capable tactical leaders required for future missions. The Adaptive Thinking Training Method and Think Like a Commander (TLAC) represent a method and a tool for training adaptive leaders.

The TLAC training program is unique in that it attempts to train a thinking task – rapid perception of the key elements of tactical situation – using cognitive drills. Prototypes have been used at U.S. Training and Doctrine Command schools that prepare officers for command at echelons from company to brigade. Despite that schoolhouse acceptance, it is important to experimentally investigate the effectiveness of the training. Training may have face validity to the instructors and students, but that does not guarantee that it is worthwhile. All too frequently training that feels right cannot be shown to result in measurable performance gains. This report documents the evaluation of student performance using the TLAC training with the Armor Captain's Career Course (ACCC) at Fort Knox, Kentucky.

The results of this research have been briefed to the Commander of 16th Cavalry Regiment, Commander of 2nd and 3rd Squadron/16th Cavalry Regiment, and to the 3/16 cadre who are instructors at the ACCC. The material has been adopted into the curriculum and is currently used in the captain's courses for both reserve and active components.



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ASSESSMENT OF THE THINK LIKE A COMMANDER TRAINING PROGRAM

EXECUTIVE SUMMARY

Research Requirement:

The research addressed in this report focuses on the need to train adaptive thinking behaviors in the area of battlefield thinking and the requirement to assess the training. The need for adaptive thinking training will increase as the U.S. Army transforms to a fast-deploying, highly adaptable force that can respond to a wide variety of threats in virtually any environment. This report documents the results of work by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) to train adaptive thinking behaviors using the Adaptive Thinking Training Method and the Think Like a Commander (TLAC) training program and to assess the effectiveness of the training.

Procedure:

The Armor Captain's Career Course at Fort Knox, Kentucky, is responsible for training and developing adaptive, self-confident combined arms leaders to perform battle command tasks in a full spectrum environment. As part of the training, students received adaptive thinking instructions using the TLAC training program. In the training, students completed a series of seven tactical vignettes and were required to identify the critical information relevant to each vignette. As the students progressed through the training program they were provided a decreasing amount of time to complete each vignette, thus, making the task more challenging. Student input and self-scores were automatically recorded to data-based files that were used for data analysis.

Findings:

An examination of student self-scores revealed significant performance gains in a key component of battlefield adaptive thinking: the rapid analysis of battlefield situations to identify key considerations for decision-making. Student scores were examined to verify that scores were not systematically increased. The performance gains were found even though time constraints were made increasingly more stringent.

Utilization of Findings:

The findings of the research have been used to advance the development of adaptive thinking training throughout the Army. To date, the training program and method have been used for active, reserve, and national guard training, and at the Armor Captain's Career Course, the Reserve Component Armor Captain's Career Course, the International Military Student Officer's course at Fort Knox, and the School for Command Preparation at Fort Leavenworth, Kansas. The U.S. Special Forces at Fort Bragg, North Carolina and Marine Corps at Quantico,

Virginia, are developing versions for their use, and the method has been transferred to a number of interested allied military organizations.

ASSESSMENT OF THE THINK LIKE A COMMANDER TRAINING PROGRAM

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ASSESSMENT OF THE THINK LIKE A COMMANDER TRAINING PROGRAM

Introduction

Our tactical leaders face a dynamic battlefield environment that places high demands on their mental agility. To emphasize the point, U.S. Army planning documents for the Future Combat Systems (FCS) specifically call out the requirement to “develop, through training and experience, the thinking, confident, versatile, adaptive, and seasoned leaders” required at the tactical level (U.S. Army Training and Doctrine Command, 2001, p. 6-29). The term adaptive thinking has been used to “describe the cognitive behavior of an officer who is confronted by unanticipated circumstances during the execution of a planned military operation” (Lussier, Ross, & Mayes, 2000). To adequately prepare leaders, we must make efficient use of opportunities to improve the skills associated with decision-making performance by conducting focused deliberate practice in battlefield thinking skills including adaptive thinking.

Based on the need, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) developed the *Adaptive Thinking Training Method* (ATTM) and the *Think Like a Commander* (TLAC) training program (Ross & Lussier, 1999; Shadrick & Lussier, 2002; Lussier, Shadrick, & Prevou, 2003). Deliberate practice exercises are used to develop thinking habits characteristic of experts, for example, to see a bigger picture, and to visualize accurately, dynamically, and proactively. Thus the ATTM focuses on creating the automatic habits that enable adaptive thinking during execution of particular tasks. The potential benefits of adaptive thinking training to Army leaders include a greater ability to respond to tactical situations, an increased training readiness, the ability to transition with limited disruption, and the ability to respond effectively to asymmetric threats.

The creation of habits of thought is particularly important because of the conditions under which military adaptive thinking occurs. Battlefield decisions do not occur in isolation or in a calm reflective environment; they must be made in a very challenging environment. Commanders must think while performing: assessing the situation, scanning for new information, dealing with individuals under stress, monitoring progress of multiple activities of a complex plan. Multitudes of events compete for their attention. Expert performance in such situations requires considerable training and extensive practice in realistic tactical situations until thinking processes become largely automatic.

Army officers, through years of study and reading, develop a broad understanding of the elements of tactical decision-making. However, that knowledge alone, no matter how extensive, is not sufficient to produce good adaptive thinking. Adaptive thinking is an active process; it is a behavior. Repetitive performance causes thinking processes to become automatic so that they can be performed quickly and accurately with less mental effort. As more elements become automatic, complex models can be developed without a proportionate increase in mental effort. This enables experts to use their knowledge flexibly and creatively in complex situations. The associated rise in automaticity and cognitive flexibility is characteristic of expert performance.

When more functions can be performed automatically, the individual has time to perform at a higher level (Schneider & Fisk, 1983). In complex activities, expert performance levels cannot

be attained without relying on the automaticity resulting from past performance. Repetitive performance causes behavior to become automatic. Therefore, it is essential that the behaviors that become ingrained conform to those of an expert - that they are the right behaviors. It is a well-known phenomenon that novices, through play alone, will improve rapidly for a short time but then may continue performing for decades without further improvement. Practice, by itself, does not make perfect. To become an expert it takes deliberate practice with opportunities for performance improvement (Ericsson, Krampe, & Tesch-Roemer, 1993).

Deliberate Practice and Adaptive Thinking

The notion that thinking can be trained as a behavior has a precedent in practice. For decades, the Soviet chess machine thoroughly dominated all competition. Chess players around the world assumed the Soviets achieved their success solely by extra effort in selecting, developing, and supporting promising players. But did the Soviets have some new and secret training methods that the rest of the world did not? Few imagined that. With the breakup of the USSR, Soviet chess academies became publishing houses. The release of such books as Mark Dvoretsky's *Secrets of Chess Training* and *Positional Play* (1997) surprised the chess world. It seemed that the Soviets did have methods they had not revealed. Subsequently, English-speaking chess trainers have written manuals that applied the Soviet methods to selected aspects of the game. For example, Andrew Soltis' book on how to calculate in chess, titled *The Inner Game of Chess* (1994), presents training exercises to develop skill at visualizing future positions by moving pieces in one's imagination.

Researchers at ARI saw a parallel between the problem of training battlefield commanders to think adaptively in tactical situations and that of training chess grandmasters. They analyzed the Soviet training manuals to understand their methods. The difference between the Soviet methods and traditional chess instruction is, in a sense, the difference between training and education. The rest of the world studied the game of chess, its strategies and tactics, and tried to understand why one move was better than another. As students studied the game, they acquired knowledge about chess and an understanding of its principles. They educated themselves about the game of chess. The Soviets did that as well, but also studied the human processes of finding good moves and avoiding errors, of searching and evaluating chess positions, and of controlling emotion and fighting a psychological battle with one's opponent. The Soviets described principles of expert play that reflected the thought patterns of grandmasters. While many of these expert principles were familiar to the rest of the world, the Soviet trainers went one critical step further. They created exercises that trained these principles, ingrain them in their students. After sufficient training, the Soviet students employed the expert thought patterns not simply because they understood the principles and not because they were consciously directing their thinking by using the expert patterns as a checklist. The cognitive behaviors had become automatic. As a result of the exercises, the students followed the principles without thinking about them, freeing their limited conscious resources to focus on the novel aspects of the contest and to think more deeply and creatively at the board. The Soviet chess trainers in essence treated the thinking that the player does during a game as a behavior - something a player does with chess knowledge as opposed to the knowledge itself - and then developed exercises to train that thinking performance to conform to that of an expert.

An expert can be defined as an individual who repeatedly demonstrates superior performance on essential tasks relevant to the domain of interest (Ericsson, Krampe, & Tesch-Roemer, 1993). Early notions of expert performance focused on differences in the amount of knowledge demonstrated; experts have more knowledge and are therefore superior performers (Ericsson & Staszewski, 1989). Later, research efforts focused on how an expert uses knowledge rather than simply on the amount of knowledge. Chase and Simon (1973) propose that while experts acquire domain-specific knowledge, they also acquire memory skills to allow for the efficient recall of knowledge. Thus, "skilled memory enables experts to rapidly encode, store and retrieve information within the domain of their expertise and thereby to circumvent the capacity limitations that typically constrain novice performance" (Ericsson & Staszewski, 1989, p. 263).

Practice is necessary to acquire expert performance. Exceptional or expert performance typically results from extended periods of intense preparation and training. Thus, intense levels of deliberate practice may accelerate the development of expert performance. The steps of deliberate practice are familiar: (a) identify the elements of expert form. One must first know how experts perform the tasks and select elements to model. The goal is to model task performance after experts. Otherwise the individual is just performing the task in his or her usual fashion and will not necessarily improve; (b) the learner performs the task while attending to the element. The expert normally performs without conscious attention to the element of form. In fact doing so would typically degrade performance. Here, however, the learner does attend to the element to ensure he or she performs it in the desired manner; (c) a coach/mentor notes discrepancies from expert form. As the learner performs the task and compares his form with the model, a coach/mentor can be important; (d) behavior is repeated until habitual. It is important that form be as correct as possible, and (e) performance without attending to the element. Conscious attention is removed. Finally, the learner tries to perform the task correctly without attending to the element of form (Lussier, Shadrick, & Prevou, 2003).

As can be seen by the above description, a key component of deliberate practice and the Adaptive Thinking Training Method is coaching, as subject matter experts (SME) observe and guide the students with regard to the expert habits. In this arena, the constructivist influence is felt strongly; coaching techniques are guided by the concept of scaffolding (Wood, Bruner, & Ross, 1976). Not unlike the scaffolding used to support construction workers, learning scaffolding is a temporary support system that enables a student to achieve a level of understanding that would not be possible without the support. The support facilitates the student learning and, as student performance improves, is gradually removed. In this way performance can rise to a higher level.

How does deliberate practice differ from actual performance or from casual exercise? Table 1 provides a description of some characteristics that distinguish deliberate practice (Lussier, Shadrick, & Prevou, 2003; Ross & Lussier, 1999).

Table 1

Characteristics of Deliberate Practice

Characteristic	Description
– Repetition	Task performance occurs repetitively rather than at its naturally occurring frequency. A goal of deliberate practice is to develop habits that operate expertly and automatically.
– Focused feedback	Task performance is evaluated by the coach or learner during performance. There is a focus on elements of form, critical parts of how one does the task.
– Immediacy of performance	After corrective feedback on task performance there is an immediate repetition so that the task can be performed more in accordance with expert norms.
– Stop and start	Because of the repetition and feedback, deliberate practice is typically seen as a series of short performances rather than a continuous flow.
– Emphasis on difficult aspects	Deliberate practice will focus on more difficult aspects. For example, when flying an airplane normally only a small percentage of one's flight time is consumed by takeoffs and landings. In deliberate practice simulators, however, a large portion of the time will be involved in landings and takeoffs and relatively little in steady level flight. Similarly, rarely occurring emergencies can be exercised very frequently in deliberate practice.
– Focus on areas of weakness	Deliberate practice can be tailored to the individual and focused on areas of weakness. During "train as you fight" performances, the individual will avoid situations in which he knows he is weak, and rightly so as there is a desire to do one's best.
– Conscious focus	Expert behavior is characterized by many aspects being performed with little conscious effort. Such automatic elements have been built from past performances and constitute skilled behavior. In fact, normally, when the expert consciously attends to the elements, performance is degraded. In deliberate practice the learner may consciously attend to the element because improving performance at the task is more important in this situation than performing one's best. After a number of repetitions attending to the element to assure that it is performed as desired, the learner resumes performing without consciously attending to the element.
– Work vs. play	Characteristically, deliberate practice feels more like work and is more effortful than casual performance. The motivation to engage in deliberate practice generally comes from a sense that one is improving in skill.
– Active coaching	Typically a coach must be very active during deliberate practice, monitoring performance, assessing adequacy, and controlling the structure of training.

Think Like a Commander Themes

The Think Like a Commander was developed to support the ATTM and is based on the use of deliberate practice principles. The aim of TLAC is to maximize the development of officers' thinking skills, teaching officers "how to think" instead of "what to think." It enables the officer to make sound decisions when the situation deviates from the expected, particularly when limited time is available to make a decision and when under extreme pressure and/or stress.

Practice alone does not make perfect; it must be structured to ensure that performance, in this case thinking, is done in a correct manner. In order to accomplish training using a deliberate practice method the student must perform selected task elements and strive to conform his or her performance to some model of 'correct form' or 'expert form.' If those desired elements of form have not been clearly identified, then the training will be inefficient, resembling discovery learning more than it does deliberate practice. A critical component in the construction of the Think Like a Commander training for tactical adaptive thinking - an explicit set of expert tactical thinking behaviors - was formulated based on ARI interviews and research with acknowledged tactical experts (Deckert, Entin, E. B, Entin, E. E., MacMillan, & Serfaty, 1994; Lussier, 1998; Ross & Lussier, 1999). These eight behaviors are termed 'themes' of the battlefield thinking. Below is a list of the themes and a brief description of each:

- **Keep a Focus on the Mission and Higher's Intent** -- Commanders must never lose sight of the purpose and results they are directed to achieve -- even when unusual and critical events may draw them in a different direction.
- **Model a Thinking Enemy** -- Commanders must not forget that the adversaries are reasoning human beings intent on defeating them. It's tempting to simplify the battlefield by treating the enemy as static or simply reactive.
- **Consider Effects of Terrain** -- Commanders must not lose sight of the operational effects of the terrain on which they must fight. Every combination of terrain and weather has a significant effect on what can and should be done to accomplish the mission.
- **Use All Assets Available** -- Commanders must not lose sight of the synergistic effects of fighting their command as a combined arms team. They consider not only assets under their command, but also those which higher headquarters might bring to bear to assist them.
- **Consider Timing** -- Commanders must not lose sight of the time they have available to get things done. Experts have a good sense of how much time it takes to accomplish various battlefield tasks. The proper use of that sense is a vital combat multiplier.
- **See the Big Picture** -- Commanders must remain aware of what is happening around them, how it might affect their operations, and how they can affect others' operations. A narrow focus on your own fight can get you or your higher headquarters blind-sided.
- **Visualize the Battlefield** -- Commanders must be able to visualize a fluid and dynamic battlefield with some accuracy and use the visualization to their advantage. A commander who develops this difficult skill can reason proactively like no other. Accurately seeing the battlefield in space, time, and purpose allows the commander to anticipate and adapt quickly to changing situations.
- **Consider Contingencies and Remain Flexible** -- Commanders must never lose sight of the old maxim that "no plan survives the first shot." Flexible plans and well-thought-out contingencies result in rapid, effective responses under fire.

The Think Like a Commander Training System

Once the behaviors to be trained were clearly specified, a prototype system was developed. The central component of the system is a set of vignettes based on tactical situations drawn from a single overarching scenario. Each vignette begins with a short – typically two to four minutes in duration – audio-video file that presents the student with a challenging tactical problem (see Figure 1). After the vignette is presented, the system prompts the students to identify critical features that need to be considered before a decision is made. As training progresses, the instructor decreases the amount of time students are allowed for this step, forcing them to adapt to increased time pressure. After the students have completed their analysis, the instructor leads a class discussion. The training system provides tools to structure the discussion and support the instructors as they discuss considerations relevant to the vignette. Such coaching by an SME is a key part of the learning process, enabling the student to develop expert habits.



Figure 1. Multimedia Vignette Presentation.

While each vignette has no officially sanctioned solution, a panel of expert battlefield commanders identified a unique set of "indicators." These are the elements of the situation – the key features – that an expert commander should consider in the specific situation before making a decision. While the themes are consistent across all vignettes, each vignette has a unique set of about 16 indicators. In the final phase of each vignette, the students see the list of expert indicators and compare it to the list they generated. The system evaluates their performance and

provides feedback in terms of the expert themes. This individual feedback complements the feedback given by the instructor. The students are then able to focus their future thinking on subsequent vignettes and place additional attention on themes for which they scored low. The training method allows students to perform repeatedly in a series of focused exercises to train the key skills involved in rapidly identifying critical features of novel military situations. Please see Lussier, Shadrick, and Prevou, (2003) for a more detailed discussion of the Think Like a Commander training program.

While the training concept is plausible in theory, and instructors and students at command schools from company through brigade have embraced Think Like a Commander training prototypes, it is important to experimentally assess the value of the training. In other words: Can we experimentally demonstrate that students improve their ability to perform significant components of adaptive thinking as a result of the training? The research reported in this paper attempts to answer that question.

Method

Participants

Participants included officers scheduled for training at Armor Captains Career Course at Fort Knox, Kentucky. A total of 24 students were randomly assigned to one of two small groups at the start of the course, each small group was led by an instructor.

Instructor Training

Each instructor received a 6-hour block of instruction on using the training materials and program of instruction. A senior instructor from the School for Command Preparation at Fort Leavenworth and the TLAC developers provided the instruction. The instruction included discussion on adaptive thinking and adaptive performance, information on how to use the training materials, and techniques for facilitating an adaptive thinking discussion. Instructors also received lesson plans that included specific information on each vignette and identified the key training objectives (Lussier, Shadrick, & Prevou, 2003). The lesson plans included links to additional information needed to facilitate the class discussion. Furthermore, the plans included specific probes instructors could use to elicit additional information from students, thus, forcing the students to think. Additionally, notes concerning the vignette were included with feedback information that could be provided to participants based on the probes instructors used.

Procedures and Data Collection

The training program was installed on every student laptop computer, as well as on the instructors' classroom workstations. Each instructor presented the audio/video vignette situation to the class using a Proxima® display unit. The presentations of the situation are typically two-three minutes in duration. After viewing the presentation, students were asked to individually list all the important considerations from the vignette – the key features of the tactical situation – by typing them in bullet form onto their computers. As a part of the training, instructors decreased the amount of time students were allowed to generate their lists for each vignette.

That is, the time conditions changed for many of the vignettes. Table 2 lists the amount of time students were allowed for each of the vignettes. After the students typed their lists onto their individual computers, the instructor led a discussion of the vignette to highlight the relevant teaching points of the vignette. The teaching points highlighted were specific elements that were directly linked to the themes. Finally, students were required to compare the lists of important considerations they initially generated with a list of critical indicators – key tactical considerations – generated by a panel of expert tacticians and to score themselves. They then received feedback on their performance based on the Think Like a Commander themes. The same procedures were used to complete seven vignettes.

Performance measures were collected to evaluate the success of the training. Specifically, the number of critical indicators identified by each student, as well as the actual student input was recorded. Since every vignette did not have the same number of critical indicators the data were converted to percentages for analysis.

Table 2

Time Allowed for Each Vignette

Vignette	Time (Minutes)
1	15
2	10
3	10
4	10
5	5
6	5
7	3

Results

Statistics for the amount of critical information identified by students on each of the seven vignettes is provided in Table 3. A total of 24 participants completed the training program. Reviewing the means for each vignette suggests, for the most part, that there is an increase in score as students completed the training. Furthermore, the standard deviation for each vignette is relatively small and consistent across all seven of the various vignettes.

Table 3

Mean and Standard Deviation for each Vignette (N = 24)

Statistic	Score on Vignette 1	Score on Vignette 2	Score on Vignette 3	Score on Vignette 4	Score on Vignette 5	Score on Vignette 6	Score on Vignette 7
Mean	6.21	7.75	8.13	8.71	8.50	9.00	10.33
Std. Deviation	1.933	2.212	1.569	2.074	.885	2.396	2.160

Figure 2 shows the mean amount of critical information identified for each of the seven vignettes used in the training based on each student's evaluation. The figure indicates that, on average, student performance increased as they progressed through the training.

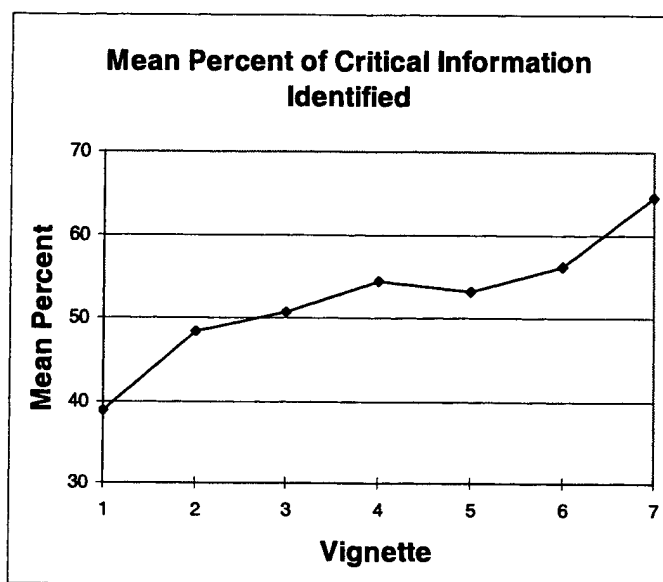


Figure 2. Mean Percent of critical information identified. (Maximum score is 16).

A repeated measures analysis of variance (ANOVA) was used to test the significance of the trend. First, Mauchly's Test of Sphericity was used to test whether the variance-covariance matrix structure was orthonormal. The results (Mauchly's $W(20) = .115$, $p < .05$) indicate that the assumption cannot be satisfied. Thus, the repeated measures ANOVA analysis used an epsilon correction for the significance test. Specifically, the Greenhouse-Geisser correction was selected because it is more conservative than the other epsilon corrections (SPSS Advanced Models 10.0, 1999).

The results of the Greenhouse-Geisser test are presented in Table 4. Compared to the critical value, $F_{crit}(4.1010, 88.216) = 2.456$, the analysis indicates a significant trend, $F(4.010, 88.216) = 12.027$, $p = .000$, for the amount of critical information identified as students progress through the training, however, there was not a significant class (i.e., instructor) or vignette by class interaction effect. The results of the within-subjects contrast confirms a significant linear

trend ($F(1,22) = 35.223, p = .000$).

Table 4

Test of Within-Subjects Effects – Self-Scores

	Source	df	F	Sig.
Vignette	Sphericity Assumed	6	12.047	.000
	Greenhouse-Geisser	4.010	12.047	.000
Vignette * Class	Sphericity Assumed	6	1.052	.395
	Greenhouse-Geisser	4.010	1.052	.385
Error	Sphericity Assumed	132		
	Greenhouse-Geisser	88.216		

Figure 3 depicts the linear pattern for the mean amount of critical information identified for each vignette for each class. As the figure indicates, the tendency was for participants to increase in the amount of critical information they identified as they progressed through the seven TLAC vignettes. Thus, indicating that students were performing at a higher level, identifying more critical information, and providing strong evidence in support of the training program. It is important to note that students improved their performance (amount of critical information identified) even though the amount of time allowed to complete the vignette was reduced throughout the training as shown previously in Table 2.

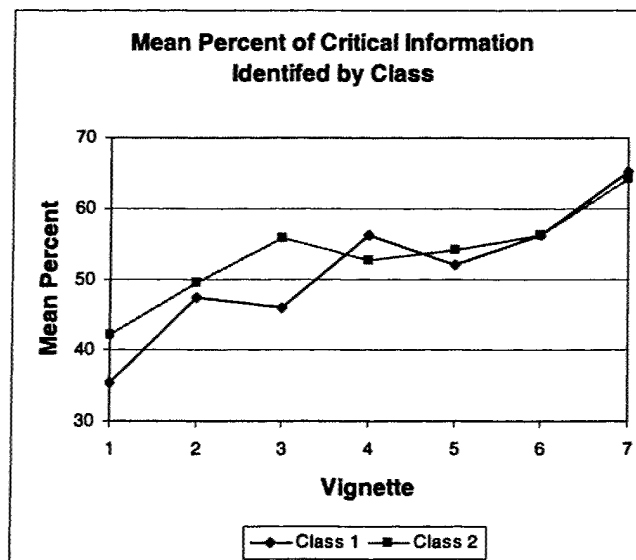


Figure 3. Mean Percent of Critical Information Identified by Class. (Maximum score is 16).

Four post-hoc comparisons with an overall alpha level of .10 were tested. Consequently, using the Bonferroni correction [$\alpha_{fw} = 1 - (1 - \alpha_{pc})^m$], the alpha level for each post-hoc comparison was $1 - (1 - .10)^4 = 0.0259$. First, the amount of critical information identified from Vignette 1 ($\bar{X} = 6.21$) was compared to the amount identified on Vignette 7 ($\bar{X} = 10.33$) to see the overall effect of the training. The results revealed a significant difference ($\bar{X}_{\text{Vig1: Vig7}} = -.125, p <$

0.0259) between the two vignettes. This shows that repeated trials with the training method leads to increases in the amount of critical information identified (see Figure 1).

In order to better understand the performance gains after repeated use with the training a number of other analyses were conducted. The amount of critical information identified from Vignette 1 was compared to the amount identified on Vignette 3. The results indicated a significance difference ($\bar{X}_{\text{vig1} : \text{vig3}} = -1.917, p < 0.0259$). Thus, students did significantly better on Vignette 3 ($\bar{X} = 8.13$) than on Vignette 1 ($\bar{X} = 6.21$).

Next, Vignette 3 was compared to Vignette 5. The results indicated that there were no significant differences ($\bar{X}_{\text{vig3} : \text{vig5}} = -.375, p > 0.0259$) between the two vignettes, thus, students did not perform better on Vignette 5 ($\bar{X} = 8.50$) than Vignette 3 ($\bar{X} = 8.13$). Finally, the scores on Vignette 5 ($\bar{X} = 8.50$) were compared to the scores on Vignette 7 ($\bar{X} = 10.33$). The results indicated a significant differences between the two vignettes ($\bar{X}_{\text{vig5} : \text{vig7}} = -1.833, p < 0.0259$).

Figure 4 combines the number of key considerations identified by the students with the time allowed and shows the average rate at which critical pieces of information were identified. For example, for Vignette 1, participants were allowed 15 minutes to complete the exercise and they considered an average of 6 considerations for the whole exercise, or a total of .41 considerations per minute. For Vignette 7, participants were allotted 3 minutes to complete the exercise and participants considered just over 10 pieces of information. This corresponds to 3.4 considerations per minute. It is important to note that fatigue was not a problem for the training since students were given ample time between vignettes. Furthermore, students were motivated by their interest and were actively involved in the training.

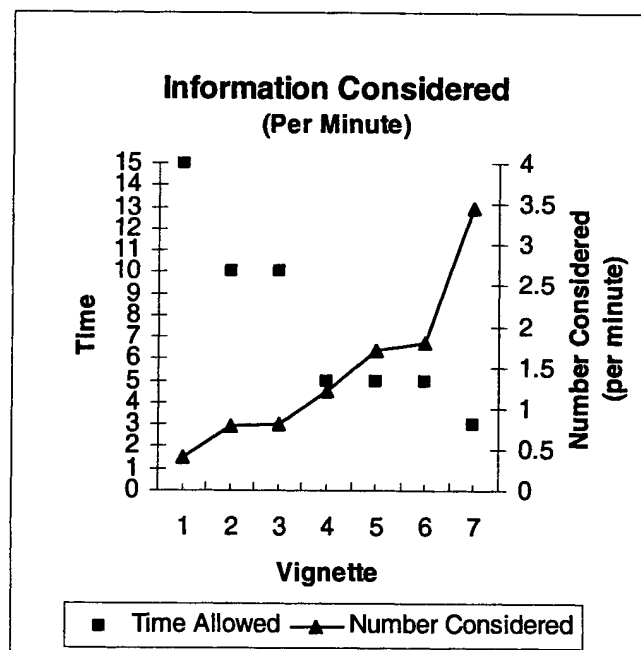


Figure 4. Information Considered by Time Allowed.

Verification Check

A potential rival hypothesis for the obtained results is that students systematically inflated their scores as training progressed. That is, students may have over estimated the self-scores of their individual performance during the training and increased their scores as they received more training. Therefore, all student responses were recorded and evaluated to verify the self-scores, i.e., the student lists were manually examined to determine the presence of critical indicators. An SME compared the student responses to the doctrinally correct solution in order to score each response. The resulting data was used to conduct the verification check. The reliability of student self-report ratings to verified-ratings was .901 indicating a strong agreement between the student and SME scores.

The Sphericity Test was examined to see whether the variance-covariance matrix structure was orthonormalized. The results (Mauchly's $W(20) = .260, p > .05$) indicate that the assumption of orthonormality is satisfied.

Thus, the results, presented in Table 5, indicates a significant linear trend, $F(6, 132) = 14.759, p < .05$, for the amount of critical information identified with repeated use. However, there was not a significant class (i.e., instructor) or vignette by class interaction effect. Further, the results of the within-subjects contrast for the verified-scores confirms a significant linear trend ($F(1,22) = 35.223, p = .000$).

Table 5

Test of Within-Subjects Effects – Verified Check

Source	df	F	Sig.
Vignette	6	14.759	.000
Vignette * Class	6	2.007	.069
Error (Vignette)	132		

As with the analysis conducted on the student self-scores, the findings indicate that there was an increase in the amount of critical information identified by participants. The amount of information identified in later vignettes was significantly greater than the amount of information identified for earlier vignettes.

Figure 5 depicts the linear pattern for the mean amount of critical information identified for each vignette using self-rating compared to the verified analysis. The figure suggests that there was a small amount of inflation of student scores for each vignette, however, the students still showed significant improvement in performance after verification.

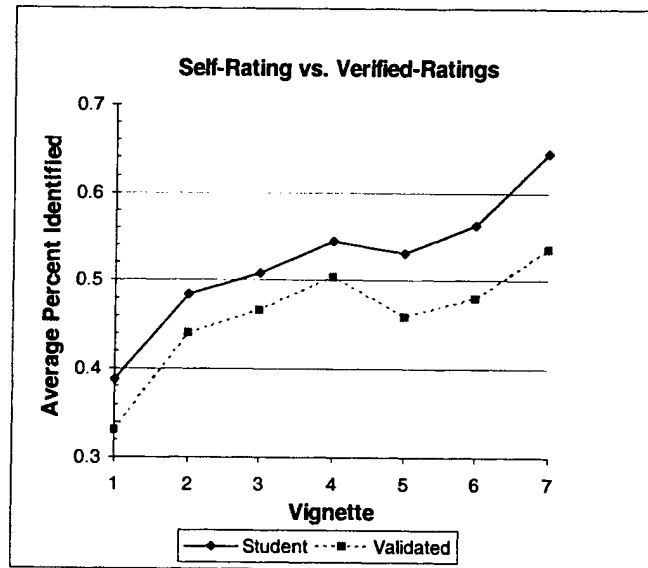


Figure 5. Average Percent Identified for Self-Scores and Verified Results.

Figure 6 illustrates the amount of student inflation for each vignette. In this case, student inflation refers to the difference between student self-ratings and SME verified ratings. As the Figure suggests, 82 to 93 percent of the student responses were verified. Further, the amount of unverified indicators increased slightly as the time allowed to complete each vignette was reduced, possibly the result of the student answers becoming more compact and cryptic as time constraints became more stringent, thus making it more difficult to verify student responses. Although we use the term inflation to describe the difference between the verified scores and the self-scores, the SME verified scores are not necessarily a more accurate representation of what considerations occurred to the students during the student performance portion of the training than are the students' own self-scores. As noted, some of the typed responses were unclear and, especially as the time limit was made severe, became cryptic. The SME verification tended to be conservative and may have tended to underestimate actual performance.

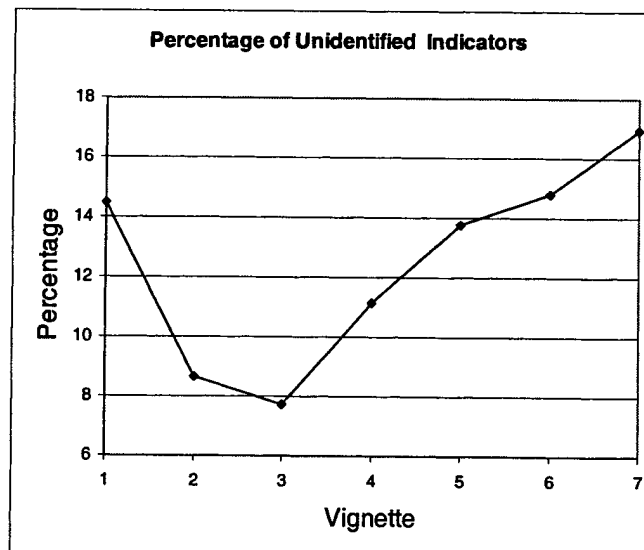


Figure 6. Percent of Unidentified Indicators.

Discussion

The work presented here is interesting because it attempts to train a cognitive behavior – thinking – using methods that have traditionally been applied to training more observable and measurable behaviors, e.g., sports performance, marksmanship and gunnery. In short, it does not greatly respect a traditional distinction between such things as physical movements, perceptions, and cognitions when it comes to training, rather treats these all as behaviors that are amenable to the same training methods and principles. Deliberate practice techniques were applied to develop exercises to train the task of adaptive thinking in tactical situations. The approach shows promise and initial data indicate significant performance gains in a key component of battlefield adaptive thinking: the rapid analysis of battlefield situations to identify key considerations for decision-making.

In this research effort data were analyzed to determine if use of the TLAC training program increased the amount of critical information students identified. Further, the investigation examined whether or not participants were able to identify greater amounts of information after using the training program even if less time was provided to complete the task. The data analysis suggests that the application of TLAC training can accelerate tactical leader development in U.S. Army Captains. Participants were able to increase the percentage of critical information considered even though they were subject to increasing time constraints. The analysis found similar results for each of the two classes, providing further evidence in support of the training method.

There are at least two limitations to the current research with regard to the method that must be addressed. First, there was no attempt made to counterbalance the order of presentation, that is, all participants progressed through the vignettes in the same order. Thus, it is possible that the vignettes became progressively easier. Subject matter expert ratings, however, suggest that there is very little variation in the difficulty level for each vignette. Yet, it would be beneficial to counterbalance the introduction of the vignettes to rule out this potential rival hypothesis.

Second, during the training students were placed under increasing time constraints. Nevertheless, students were required to type their solutions for each vignette. The analysis of student input suggests that reducing the time limited the students' ability to clearly articulate important aspects of the scenario. In fact, many of the responses on later vignettes were very cryptic making the verification process difficult. Thus, there is a conflict between the goals of the TLAC training and the desire to collect student responses for data analysis. Consequently, students may have shown even greater advances in performance if the time was not reduced so drastically or if the students were allowed to speak their responses instead of typing them.

Two important and related considerations are transfer of the skills trained by TLAC to more realistic whole-task situations and degree of automaticity of the thinking behaviors. Neither an assessment of transfer nor of automaticity has been accomplished. It is unlikely that seven short vignette-based exercises involved sufficient repetition to reach even a low degree of automaticity. It has been noted, however, that instructors who participated in the training evaluation continued to provide coaching based on the themes as students participated in other

exercises, including more complete simulation-based exercises. Both automaticity and transfer are a result of continued production of the behaviors performed in the training vignettes in a variety of tactical exercise settings.

In the current research a model to train adaptive thinking skills under increasing time pressures and an experimental test of the training strategy are described. While the results suggest that the ATTM and TLAC provide a suitable environment for training adaptive leaders, more work needs to be done.

We are investigating the pattern of development of tactical thinking related to the themes. If the development of tactical thinking skills follows a consistent and discernable pattern then individual performance levels can be diagnosed, and training can be more efficiently targeted to individual needs. One consistent finding from a number of efforts (Deckert, et al., 1994; Ross, et al., 1999; Carnahan, Lickteig, Sanders, & Durlach, 2004) shows that in novices the amount of attention focused on own forces, i.e., the theme Use All Assets Available, is much higher than the amount of attention placed on the enemy, i.e., the theme Model a Thinking Enemy, but becomes more balanced or reverses with the development of greater expertise. The finding has been noted in other fields, e.g., chess, where it is a frequent observation that novices focus on their own plans and moves and seem to ignore what the opponent is doing. One explanation is that in order to act one must consider 'own forces,' and such consideration virtually exhausts the capacity of the novices to build, maintain, and operate their mental models. Only with increasing expertise are models of sufficient complexity to encompass both 'own forces' and 'enemy forces' possible. Another explanation (Ross, et al., 1999) is based on the tendency of novices in all domains of expertise to jump to solutions before gaining a sufficiently deep understanding of the situation.

Other research based on Think Like a Commander training development focuses on the method of delivering coaching. Good coaching is seen as an integral part of the training method. In the work reported here instructors performed the coaching, i.e., live coaches were employed. Other research efforts currently underway are investigating various alternative methods of delivering the coaching component, including intelligent tutors, non-interactive presentations, live but distant coaches, asynchronous interaction with a live coach, and collaborative student groups (Gossman, Heiden, Flynn, Smith, & Shadrack, in preparation).

Conclusions

Experience implementing the ATTM and TLAC with the Armor Captains Career Course into course curriculum suggests that adaptive thinking training (i.e., TLAC) is feasible and can provide a valuable learning experience for students. Additional work is needed to introduce the training to a wider audience and to insure maximum training value using various delivery methods (e.g., face-to-face, distance, etc.). In addition, the method needs to be transitioned to other battlefield operating systems. That is, the current research focused on students with a strong background in armor. Additional work is needed to investigate the effectiveness of this training method with officers with different backgrounds.

As the Army moves closer to the Future Force, the need for adaptive officers will become even more critical. As information processing needs increase and available time decreases, officers need training to meet the dynamic demands of the future battlefield. One approach for workload reduction and automaticity is based on the premise that practicing some skills may “free cognitive resources for higher level decision-making” (Cohen, Freeman, & Thompson, 1998, p. 155). Think Like a Commander training attempts to address this issue using a deliberate practice method. Thus, the implication of the training is that officers completing this training may be better prepared to deal with unexpected situations under times of stress.

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